APPENDIX D | TECHNICAL APPENDIX DESCRIBING DERIVATION OF IMPACTS TO TIMBER ACTIVITIES

1. This Appendix is divided into two sections. The first provides details on the on the derivation of impacts resulting from expected changes to timber activities within the study area. The second provides a sensitivity analysis for the results, based on different assumptions regarding the amount of pre-commercial thinning expected in the study area.

D.1 DERIVATION OF TIMBER IMPACTS

2. This analysis considers the impacts of changes in timberland management resulting from lynx conservation efforts.[1] The analysis of timber-related impacts considers two scenarios, representing varying levels of lynx conservation efforts.

D.1.1 SCENARIO 1

3. The first scenario assumes landowners implement existing lynx management plans where available, and for all other areas, only initial lynx conservation efforts are undertaken. Under this scenario, three types of impacts are quantified (as detailed in Exhibits D-1 and D-2 for pre- and post-designation impacts, respectively):

    1. Impacts expected to result from implementation of existing lynx management plans and strategies.
    2. Project modifications to timber projects requiring access across Federal lands.
    3. Costs of researching and developing lynx management guidelines.

[1] The analysis does not calculate regional economic impacts related to timber activities given the lengthy timeframe and uncertainty of expected impacts.

EXHIBIT D-1. DERIVATION OF PRE-DESIGNATION SCENARIO 1 COST ESTIMATES

CRITICAL HABITAT UNIT	SUBUNIT	COSTS OF IMPLEMENTING EXISTING LYNX PLANS	PROJECT MODIFICATION COSTS	COST OF DEVELOPING LYNX MANAGEMENT PLANS
Unit 2: Minnesota	Superior National Forest	$150,000 in 2005 (1)	$30,000 (2)	Included in Section 6
Unit 2: North Cascades	WADNR	$1.02 million/year (3)	None	Included in Section 6

Sources:
(1) Costs of $150,000 per year to implement revised forest plan lynx timber-related standards & guidelines beginning in 2005. Email and personal communication with Mary Shedd, Superior NF, March 7 and March 17, 2006.
(2) Includes road decommissioning costs related to two projects in 2002, three projects in 2003, and one project in 2005; $5,000 per project. IEc analysis of consultation history and personal communication with Mary Shedd, Superior NF, March 17, 2006.
(3) Cost of compliance with all aspects of lynx management plan. Personal communication with Scott Fisher, WADNR, March 16, 2006 (as revised).

Existing Lynx Management Plans

4. Four subunits have or are planning to adopt some form of lynx conservation guidance covering timber practices. These include Conservation NGO lands in Maine owned by the Nature Conservancy, Superior National Forest, Montana Department of Natural Resource Conservation (MTDNRC) and Washington Department of Natural Resources (WADNR) lands. These existing conservation efforts are described briefly below.

5. ***The Nature Conservancy*** owns an area of the St. John River Forest, of which 133,255 acres are "Managed Forest," managed by the Huber Resources Corporation. The management plan includes conservation efforts to benefit the lynx including:

   - "At the present time, the Conservancy does not plan to use pre-commercial thinning as it represents a significant, low priority investment without ecological or biodiversity benefits, and is counter to lynx habitat needs."
   - "For Canada lynx the goal is to provide adequate early succession habitat to maintain a food source (i.e., hare) for a viable Canada lynx population. Given the large proportion (28%) of regenerating softwood forest on the Conservancy's ownership, this goal is considered met for the near future**.** (As further research on the individual home range requirements of lynx, and the effects of partial harvest and pre-commercial thinning on both lynx and hare, are conducted, this goal will be further refined.)"[2]

[2] Stockwell, Kyle. Upper St. John River Forest Management Plan, April 25, 2003. Update September 2004. Prepared for the Nature Conservancy (Land Owner) and Huber Resources (Land Manager).

EXHIBIT D-2. DERIVATION OF POST-DESIGNATION SCENARIO 1 COST ESTIMATES (2006 – 2025)

CRITICAL HABITAT UNIT	SUBUNIT	COSTS OF IMPLEMENTING EXISTING LYNX PLANS	PROJECT MODIFICATION COSTS	COST OF DEVELOPING LYNX MANAGEMENT PLANS (7)	TOTAL UNDISCOUNTED COSTS (2006 – 2025)
Unit 1: Maine	Maine Dept. of Conservation	None	None	Included in Section 6	None
	Conservation NGO	$5,170,000 (1)	None	Included in Section 6	$5,170,000
	Private Timber Lands	None	None	$31,100,000	$31,100,000
	Unknown	None	None	$1,640,000	$1,640,000
Unit 2: Minnesota	Superior National Forest	$3,000,000 (2)	$500,000 (3) (4)	Included in Section 6	$3,500,000
	MNDNR	None	None	Included in Section 6	None
	Private Timber Lands	None	None	$295,000	$295,000
	Unknown	None	None	$5,320,000	$5,320,000
Unit 3: Northern Rockies	MTDNRC	$42,200,000 (1)	$800,000 (5)	Included in Section 6	$43,000,000 (1)
	Montana University System	None	None	Included in Section 6	None
	Idaho Dept. of Land	None	None	Included in Section 6	None
	Private Timber Lands	None	None	$2,680,000	$2,680,000
	Unknown	None	None	$3,920,000	$3,920,000
Unit 4: North Cascades	WADNR	$20,500,000(6)	None	Included in Section 6	$20,500,000 (6)

Sources:

(1) Impacts of precluding pre-commercial thinning (see Exhibits D-5 through D-8 for details); costs estimated over 100 years, then annualized to estimate costs over a 20 year period.

(2) Cost to implement forest plan lynx timber-related standards & guidelines of $150,000 per year over 20 years. Email and personal communication with Mary Shedd, Superior NF, March 7 and March 17, 2006.

(3) Road decommissioning costs of $5,000 for one project per year over 20 years. IEc analysis of consultation history and personal communication with Mary Shedd, Superior NF, March 17, 2006.

(4) Alternative road building costs to avoid federal access for five projects per year at $4,000 per project over 20 years. IEc analysis of consultation history and personal communication with Mike Houser, Potlatch Corporation, April 14, 2006.

(5) $40,000 per year over 20 years assuming 10 projects per year based on 20% of MTDNRC acres needing federal access. Personal communication with Scott McLeod April 14, 2006. Per project cost to build alternative roads is $4,000; based on personal communication with Mike Houser, Potlatch Corporation, April 14, 2006.

(6) Estimate of $1.02 million provided by WADNR based on compliance with lynx management plan. Personal communication with Scott Fisher, WADNR, March 16, 2006.

(7) For Private timber lands and Unknown landowners, costs of lynx plan development are based on a weighted average per acre cost of $5.73 per acre spread over six years (2006 – 2011) and associated survey and monitoring costs of $45,230 per year for the following five years (See Exhibit D-6 for acreage of subunits and Exhibit 6-4 for details on development of per acre costs). Costs for public and conservation lands are included in Section 6.

6. ***Superior National Forest*** operated under an agreement with the Service to implement the LCAS from 2000 until its revised forest plan was published in 2004.[3] Superior National Forest's revised Forest Plan includes measures similar to the LCAS. With regard to areas outside lynx analysis units (LAUs) included in the study area, the revised forest plan states:

> "Exceptions to management and analysis at the LAU scale may also be warranted for some projects where it is determined that the lynx may occur in areas outside of mapped LAUs and projects may affect the lynx."[4]

7. Superior National Forest indicated that it applies similar guidelines, defining an area similar in size to an LAU, in order to review projects that fall outside of mapped LAUs.[5]

8. ***MTDNRC*** is currently drafting a habitat conservation plan (HCP) under which pre-commercial thinning may occur at a delayed interval to benefit the lynx. As MTDNRC has not yet published its draft HCP, the analysis applies the assumption that pre-commercial thinning will be precluded under Scenario 1.

MTDNRC Habitat Conservation Plan – Excerpts of Lynx Strategy

Commitments for Lynx Management Areas (LMAs)

- Maintain 65 percent as suitable lynx habitat
- No more than 15 percent of lynx habitat converted to non-suitable per decade per LMA
- Maintain at least 20 percent as forage habitat

Commitments for all HCP covered lands in lynx habitat

- Retain two potential den sites per square mile
- Leave one percent of downed woody material
- No mechanical harvest with 0.25 miles of den sites from May 1 – July 15
- Emphasize retention of downed large logs (>15 inches)
- Retain some shade tolerant trees in pre-commercially thinned areas

Source: Montana Department of Natural Resource Conservation. 2005. Lynx Conservation Strategy. October 2005. Available at http://dnrc.mt.gov/HCP/speciesacct.asp.

[3] USDA, Forest Service. 2000. Canada Lynx conservation agreement. February 7, 2000. US Forest Service and US Fish and Wildlife Service. USFS Agreement #00-MU-11015600-013.

[4] USFS, Superior National Forest. Land and Resource Management Plan Superior National Forest. July 2004. Available online at http://www.fs.fed.us/r9/forests/superior/projects/forest_plan/2004_forest_plan.php

[5] Personal Communication, Mary Shedd, Wildlife Biologist, Superior National Forest, February 21, 2006. These impacts may be overstated as they would have been incurred regardless of lynx conservation efforts.

9. ***WADNR*** developed a lynx management plan in 1996. After the lynx was listed in 2000, the Service recommended changes to the plan, which has recently been revised and is currently undergoing review. Exhibit D-3 presents the major guidelines included in the plan, which are similar to LCAS measures. WADNR estimates that approximately 30 percent of their timberlands are effectively set-aside due to lynx conservation efforts, due to the requirements of the lynx plan. Information related to past costs was not provided, but is assumed to have been similar to estimated future costs as the conservation guidelines suggested by the Service have not changed since 2000.

EXHIBIT D-3. WADNR LYNX MANAGEMENT PLAN

WADNR LYNX PLAN STANDARDS
1. Quality snowshoe hare habitat, located within lynx Forage Habitat, will be maintained by providing adequate horizontal cover above average snow depth.
2. To ensure that potential denning structure is available across the landscape, at least two den sites per square mile will be provided in all Lynx Management Zones where WADNR manages at least one square mile.
3. Potential human disturbance to den sites and Denning Habitat will be minimized. Roads will be far from dens and timber harvest will not occur during denning season.
4. The following ratios of lynx habitat components will be maintained in each LAU on DNR-managed lands where DNR manages 20 percent or more of the LAU: o Forage Habitat 20% minimum o Denning Habitat 10% minimum (including at least 2 den sites/mi2) o Travel Habitat 40% o Temporary Non-lynx Areas 30% maximum
Source: WADNR draft Lynx Habitat Management Plan, pages 32-45.

Project Modifications

10. Based on a review of the consultation history and discussions with land managers, project modifications are expected to occur in two subunits under this scenario: Superior National Forest and MTDNRC. Conservation needs may result in modifications to timber projects requiring that new or reconstructed roads be closed after the project, in part to benefit lynx. Thus, estimated impacts include road decommissioning costs. In addition, federal review of access permits may delay projects from one month to two years or more in some instances.[6] The analysis estimates costs of building alternative roads in lieu of obtaining an access permit.[7]

[6] Personal communication with Mike Houser, Potlatch Corporation April 14, 2006. Personal communication Scott McLeod, MTDNRC, April 14, 2006.

[7] Note that the analysis does not anticipate any changes to the current exemption from U.S. Army Corps of Engineering 404 wetlands permits for roads constructed and used specifically for timber access; however, stakeholders have expressed concern that if this exemption were affected by lynx conservation efforts this could result in extensive impacts.

Preparation of Lynx Management Plans

11. For areas that have not undertaken any specific lynx management planning to date, the analysis estimates costs related to this type of conservation effort. Specifically, for Private timber lands and Unknown landowners, costs of lynx plan development are based on a weighted average per acre cost of $5.73 per acre spread over six years (2006 – 2011) and associated survey and monitoring costs of $45,230 per year for the following five years (See Exhibit D-6 for acreage of subunits and Exhibit 6-4 for details on development of per acre costs). Costs of preparing lynx management plans for public and conservation lands are included in Section 6.

12. Exhibit D-4 provides an example to illustrate the calculation of Scenario 1 impacts, based on the Superior National Forest subunit.

EXHIBIT D-4. SUPERIOR NATIONAL FOREST SUBUNIT: EXAMPLE OF SCENARIO 1 IMPACT CALCULATION (2006- 2025)

YEAR	COSTS OF IMPLEMENTING EXISTING LYNX PLANS	PROJECT MODIFICATION COSTS	COST OF DEVELOPING LYNX MANAGEMENT PLANS	SCENARIO 1 IMPACTS		
				UNDISCOUNTED	PRESENT VALUE 3%	PRESENT VALUE 7%
A	*B*	*C*	*D*	*E =A+B+C*	*F = E / (1.03)^(A-2006)*	*G = E / (1.07)^(A-2006)*
2006	$150,000	$25,000	$0	$175,000	$175,000	$175,000
2007	$150,000	$25,000	$0	$175,000	$170,000	$164,000
2008	$150,000	$25,000	$0	$175,000	$165,000	$153,000
2009	$150,000	$25,000	$0	$175,000	$160,000	$143,000
2010	$150,000	$25,000	$0	$175,000	$155,000	$133,000
2011	$150,000	$25,000	$0	$175,000	$151,000	$125,000
2012	$150,000	$25,000	$0	$175,000	$147,000	$117,000
2013	$150,000	$25,000	$0	$175,000	$142,000	$109,000
2014	$150,000	$25,000	$0	$175,000	$138,000	$102,000
2015	$150,000	$25,000	$0	$175,000	$134,000	$95,200
2016	$150,000	$25,000	$0	$175,000	$130,000	$89,000
2017	$150,000	$25,000	$0	$175,000	$126,000	$83,100
2018	$150,000	$25,000	$0	$175,000	$123,000	$77,700
2019	$150,000	$25,000	$0	$175,000	$119,000	$72,600
2020	$150,000	$25,000	$0	$175,000	$116,000	$67,900
2021	$150,000	$25,000	$0	$175,000	$112,000	$63,400
2022	$150,000	$25,000	$0	$175,000	$109,000	$59,300
2023	$150,000	$25,000	$0	$175,000	$106,000	$55,400
2024	$150,000	$25,000	$0	$175,000	$103,000	$51,800
2025	$150,000	$25,000	$0	$175,000	$100,000	$48,400
Total	$3,000,000	$500,000	$0	$3,500,000	$2,680,000	$1,980,000
Annualized				$175,000	$180,000	$187,000

D.1.2 SCENARIO 2

13. As discussed in Section 3, Scenario 2 focuses on the LCAS conservation measure that states "Pre-commercial thinning will be allowed only when stands no longer provide snowshoe hare habitat."[8] Forecast timber impacts under Scenario 2 include:

    1. Impacts as estimated under Scenario 1; plus
    2. Impacts of eliminating pre-commercial thinning activity, resulting in forgone timber harvest.

    These two components are summed across each year and the present value of the stream of impacts is calculated according to the formulas presented in Section 1.

Pre-Commercial Thinning Impacts

14. Pre-commercial thinning impacts are estimated over a 100-year timeframe.[9] Rotation schedules vary across the study area and are dependent on species mix and timber management regime. The analysis of pre-commercial thinning impacts has several limitations, see Section 3.3 for a discussion of these caveats.

15. In Maine, a previously conducted study provides a robust estimate of the benefits of pre-commercial thinning.[10] To estimate impacts for Maine, the model applies the per-acre net present value amount from this model to the acreage of timberland in each subunit, as illustrated in Exhibit D-5.

[8] Ruediger, B., et. al. 2000.

[9] Rotations vary from 40 to 120 years across the study area depending on species. This time frame was chosen in part to match the University of Maine model (Wagner et. al., 2003) used to assess silvicultural research priorities in Maine, which is applied in this analysis. However, these results are annualized in order to present results over a 20 year period.

[10] Wagner, Robert G., Bowling, Ernest, and Seymour, Robert. 2003. Assessing Silviculture Research Priorities for Maine Using Wood Supply Analysis. Technical Bulletin 186. February 2003 Maine Agricultural and Forest Experiment Station. The University of Maine. Accessed at http://library.umaine.edu/cfru/pubs/CFRU309.pdf on March 14, 2006. Additional model runs provided by Ernest Bowling, JW Sewall on June 15, 2006.

EXHIBIT D-5. PRE-COMMERCIAL THINNING IMPACTS: MAINE

SUBUNIT	TIMBERLAND ACREAGE [1]	UNDISCOUNTED IMPACTS (2006 – 2105) [2]		
		UNDISCOUNTED	3% DISCOUNT RATE	7% DISCOUNT RATE
Maine Dept. of Conservation	290,170	$56,300,000	$9,910,000	$5,230,000
Private Timber Lands	5,385,955	$1,050,000,000	$184,000,000	$97,100,000
Conservation NGO	140,570	$27,300,000	$4,800,000	$2,540,000
Unknown	247,421	$48,000,000	$8,450,000	$4,460,000
Total	9,335,880	$1,180,000,000	$207,000,000	$109,000,000

Notes: Totals may not sum due to rounding.
(1) Based on IEc GIS analysis, except for Maine Conservation NGO lands, based on info from Stockwell, et al. 2004. The Nature Conservancy. Upper St. John River Forest: Forest Management Plan, April 25, 2003. Update: September 2004, Appalachian Mountain Club, May 5, 2006.
(2) Acreage multiplied by per acre benefits of pre-commercial thinning. Per-acre benefits estimated to be $194/acre (undiscounted); $34/acre (3% discount rate) and $18/acre (7% discount rate) based on NPV calculated in Wagner et. al (2003) and additional model runs provided by JW Sewall.

16. For Minnesota and Montana, a more simplified analysis was conducted to estimate net impacts. Based on estimates of pre-commercially thinned acreage, per acre costs of pre-commercial thinning, and studies of the benefits attributable to pre-commercial thinning, the analysis estimates the impacts of precluding pre-commercial thinning in each unit. Estimated pre-commercial thinning acreage is presented in Exhibit D-6. Several sources indicated one percent per year of acreage pre-commercially thinned is an acceptable assumption.[11] Details on the underlying assumptions and derivation of pre-commercial thinning impacts are shown in Exhibit D-7. Exhibit D-8 provides additional explanation of the calculation of pre-commercial thinning impacts for Minnesota and Montana. Finally, Exhibits D-9 and D-10 provide an example to illustrate the calculation of pre-commercial thinning impacts and Scenario 2 impacts overall, based on the Superior National Forest subunit.

[11] Personal communication with: Scott McLeod, MTDNRC, April 10, 2006; Bill Berguson, NRRI, April 6, 2006; Jon Nelson, MNDNR, March 8, 2006; Cheryl Adams, UPM Blandin March 14, 2006; and Tom Ray, Plum Creek Timber Company, June 30, 2006. Also, F.H. Stoltze Land & Lumber Co. Comments on potential impacts of designation of Critical Habitat for Canada Lynx. Provided via facsimile on February 21, 2006.

EXHIBIT D-6. ACREAGE BY SUBUNIT

CRITICAL HABITAT UNIT	SUBUNIT	TIMBERLAND ACREAGE (1)	ANNUAL ACREAGE OF PRE-COMMERCIAL THINNING (2)
Unit 1: Maine	Maine Dept. of Conservation	290,170	Model applied in Maine assumes 20,000 acres per year statewide
	Private Timber Lands	5,385,955	
	Conservation NGO	140,570	
	Unknown	247,421	
Unit 2: Minnesota	Superior National Forest (3)	473,366	4,734
	MNDNR	507,473	5,075
	Private Timber Lands	12,074	121
	Unknown	889,522	8,895
Unit 3: Northern Rockies	MTDNRC	189,771	1,500
	Montana University System	21,656	217
	Idaho Dept. of Land	646	100 (one time)
	Private Timber Lands	428,205	4,282
	Unknown	644,028	6,440
Unit 4: North Cascades	WADNR	105,023	n/a (WADNR estimates impact of all conservation efforts combined)
Total		9,335,880	

Notes:

(1) Based on IEc GIS analysis, except for Maine Conservation NGO lands, based on info from Stockwell, et al. 2004. The Nature Conservancy. Upper St. John River Forest: Forest Management Plan, April 25, 2003. Update: September 2004, Appalachian Mountain Club, May 5, 2006.

(2) Based on assumption that one percent of timberlands are per-commercially thinned per year, except where specific information was available as follows: For MTDNRC, 1,500 acres per year is based on personal communication with Scott McLeod, MTDNRC, April 10, 2006. For Idaho Department of Lands, only 100 acres total are expected to be thinned within the study area over the analysis timeframe (personal communication with Patrick Seymour, March 15, 2006).

(3) Superior National Forest does not conduct pre-commercial thinning; therefore, this LCAS guideline was not included in its forest plan. However, private, state and county lands are included in this subunit as inholdings, and therefore costs associated with a limitation on pre-commercial thinning are relevant to the quantification of impacts in this subunit.

EXHIBIT D-7. ASSUMPTIONS UNDERLYING ANALYSIS OF PRE-COMMERCIAL THINNING IMPACTS

CRITICAL HABITAT UNIT	SUBUNIT	PER-ACRE IMPACT OF PRE-COMMERCIAL THINNING (2006 - 2105) [6]			BASIS FOR PRE-COMMERCIAL THINNING IMPACTS
		UNDISCOUNTED	3% DISCOUNT RATE	7% DISCOUNT RATE	
Unit 1: Maine	All Subunits	$194	$34	$18	Estimate based on NPV of benefits per acre with pre-commercial thinning (over a 100 year time period statewide). (1)
Unit 2: Minnesota	All Subunits	$407	$57	$1	Based on increased yield of 10 cords per acre on acreage treated with pre-commercial thinning, with average stumpage value of $65/cord. Assumes pre-commercial thinning occurs at age 10 (year 1) and harvest occurs at age 40 (year 30). (2)
Unit 3: Northern Rockies	MTDNRC	$1,364	$102	$0	Based on increased yield of 10 mbf per acre on acreage treated with pre-commercial thinning, with average stumpage value of $405/mbf. Assumes pre-commercial thinning occurs at age 20 (year 1) and harvest occurs at age 85 (year 65). (3) For Idaho Dept. of Lands, impacts based solely on time value of money. Expected pre-commercial thinning will reduce time to harvest from age 35 to age 20. (4)
	Montana University System				
	Unknown				
	Private Timber Lands				
	Idaho Dept. of Land				
Unit 4: North Cascades	WADNR	$975	$317	$149	Impacts based on compliance with all aspects of lynx management plan. (5)

Notes:

(1) Wagner, Robert G., Bowling, Ernest, and Seymour, Robert. 2003. Assessing Silviculture Research Priorities for Maine Using Wood Supply Analysis. Technical Bulletin 186. February 2003 Maine Agricultural and Forest Experiment Station. The University of Maine. Accessed at http://library.umaine.edu/cfru/pubs/CFRU309.pdf on March 14, 2006. Additional model runs by Ernest Bowling, JW Sewall on June 15, 2006.

(2) Personal communication with Bill Berguson NRRI, April 6, 2006; Natural Resource Research Institute, Winter 1999. "Aspen Thinning Improves Timber Yield." Available at http://www.nrri.umn.edu/default/nows/1999nows/w99now.pdf; and, 2005 Stumpage Price Report faxed by Jon Nelson 4-7-06; price for Aspen pulp & bolts.

(3) Personal communication with Scott McLeod, MTDNRC, April 10, 2006; BBER, U. MT, Montana Sawlog and Veneer Log Price Report, July - September, 2005. Accessed at: http://www.bber.umt.edu/content/?x=1084.

(4) Email communication from Patrick Seymour, Idaho Department of Lands, March 15, 2006.

(5) Estimates provided by WADNR are included in Scenario 1 and are based on compliance with all aspects of lynx management plan. Personal communication with Scott Fisher, WADNR, March 16, 2006.

(6) For Unit 3, benefits are shown as zero, assuming that seven percent discount rate is inappropriate discount rate as it results in net benefits to the land manager of precluding pre-commercial thinning.

EXHIBIT D-8. ANALYSIS OF PRE-COMMERCIAL THINNING IMPACTS: MINNESOTA AND MONTANA

CRITICAL HABITAT UNIT	SUBUNIT	ANNUAL PRE-COMMERCIAL THINNING ACREAGE (1)	CALCULATION OF COST SAVINGS			CALCULATION OF LOST VALUE DUE TO DECREASED YIELD		
			COST PER ACRE OF PRE-COMMERCIAL THINNING (2)	ANNUAL COST SAVINGS	YEARS ACCRUED (3)	PER ACRE VALUE OF DECREASED YIELD WITHOUT PRE-COMMERCIAL THINNING (3)	ANNUAL LOST VALUE	YEARS ACCRUED (3)
Unit 2: Minnesota	Superior National Forest	4,734	$81	$383,000	2006 – 2065	$650	$3,080,000	2036 -2105
	MNDNR	5,075	$81	$411,000	2006 – 2065	$650	$3,310,000	2036 -2105
	Private Timber Lands	121	$81	$9,870	2006 – 2065	$650	$78,700	2036 -2105
	Unknown	8,895	$81	$721,000	2006 – 2065	$650	$5,790,000	2036 -2105
Unit 3: Northern Rockies	MTDNRC	1,500	$132	$198,000	2006 - 2039	$450	$6,230,000	2071 – 2105
	Montana University System	217	$132	$28,600	2006 - 2039	$450	$900,000	2071 – 2105
	Private Timber Lands	4,282	$132	$565,000	2006 - 2039	$450	$17,800,000	2071 – 2105
	Unknown	6,440	$132	$850,000	2006 - 2039	$450	$26,800,000	2071 – 2105

Notes: Totals may not sum due to rounding.
(1) See Exhibit D-5.
(2) Minnesota regional average based on cost estimates provided by Lake County Lands Department, MNDNR, UPM Blandin, Natural Resource Research Institute, and Potlatch Corporation. Montana regional average based on cost estimates provided by USFS Region 1, Idaho Department of Land, and MTDNRC.
(3) Based on assumptions outlined in Exhibit D-7.

EXHIBIT D-9. SUPERIOR NATIONAL FOREST SUBUNIT: EXAMPLE OF PRE-COMMERCIAL THINNING IMPACT CALCULATION (2006- 2105)

YEAR	COST OF PRE-COMMERCIAL THINNING	LOST VALUE FROM NOT PRE-COMMERCIAL THINNING	NET IMPACTS OF PRECLUDING PRE-COMMERCIAL THINNING		
			UNDISCOUNTED	PRESENT VALUE 3%	PRESENT VALUE 7%
A	*B*	*C*	*D = C - B*	*E = D / (1.03)^(A-2006)*	*F = D / (1.07)^(A-2006)*
2006	$383,000	$0	($383,000)	($383,000)	($383,000)
2007	$383,000	$0	($383,000)	($372,000)	($358,000)
2008	$383,000	$0	($383,000)	($361,000)	($335,000)
2009	$383,000	$0	($383,000)	($351,000)	($313,000)
2010	$383,000	$0	($383,000)	($341,000)	($293,000)
2011	$383,000	$0	($383,000)	($331,000)	($273,000)
2012	$383,000	$0	($383,000)	($321,000)	($255,000)
2013	$383,000	$0	($383,000)	($312,000)	($239,000)
2014	$383,000	$0	($383,000)	($303,000)	($223,000)
2015	$383,000	$0	($383,000)	($294,000)	($209,000)
2016	$383,000	$0	($383,000)	($285,000)	($195,000)
2017	$383,000	$0	($383,000)	($277,000)	($182,000)
2018	$383,000	$0	($383,000)	($269,000)	($170,000)
2019	$383,000	$0	($383,000)	($261,000)	($159,000)
2020	$383,000	$0	($383,000)	($253,000)	($149,000)
2021	$383,000	$0	($383,000)	($246,000)	($139,000)
2022	$383,000	$0	($383,000)	($239,000)	($130,000)
2023	$383,000	$0	($383,000)	($232,000)	($121,000)
2024	$383,000	$0	($383,000)	($225,000)	($113,000)
2025	$383,000	$0	($383,000)	($219,000)	($106,000)
2026	$383,000	$0	($383,000)	($212,000)	($99,100)
2027	$383,000	$0	($383,000)	($206,000)	($92,600)
2028	$383,000	$0	($383,000)	($200,000)	($86,500)
2029	$383,000	$0	($383,000)	($194,000)	($80,900)
2030	$383,000	$0	($383,000)	($189,000)	($75,600)
2031	$383,000	$0	($383,000)	($183,000)	($70,600)
2032	$383,000	$0	($383,000)	($178,000)	($66,000)
2033	$383,000	$0	($383,000)	($173,000)	($61,700)
2034	$383,000	$0	($383,000)	($168,000)	($57,700)
2035	$383,000	$0	($383,000)	($163,000)	($53,900)
2036	$383,000	$3,080,000	$2,700,000	$1,110,000	$355,000
2037	$383,000	$3,080,000	$2,700,000	$1,080,000	$331,000
2038	$383,000	$3,080,000	$2,700,000	$1,050,000	$310,000
2039	$383,000	$3,080,000	$2,700,000	$1,018,000	$290,000
2040	$383,000	$3,080,000	$2,700,000	$988,000	$271,000
2041	$383,000	$3,080,000	$2,700,000	$960,000	$253,000
2042	$383,000	$3,080,000	$2,700,000	$932,000	$236,000
2043	$383,000	$3,080,000	$2,700,000	$904,000	$221,000
2044	$383,000	$3,080,000	$2,700,000	$878,000	$206,000
2045	$383,000	$3,080,000	$2,700,000	$853,000	$193,000
2046	$383,000	$3,080,000	$2,700,000	$828,000	$180,000
2047	$383,000	$3,080,000	$2,700,000	$804,000	$169,000
2048	$383,000	$3,080,000	$2,700,000	$780,000	$157,000

YEAR	COST OF PRE-COMMERCIAL THINNING	LOST VALUE FROM NOT PRE-COMMERCIAL THINNING	NET IMPACTS OF PRECLUDING PRE-COMMERCIAL THINNING		
			UNDISCOUNTED	PRESENT VALUE 3%	PRESENT VALUE 7%
2049	$383,000	$3,080,000	$2,700,000	$757,000	$147,000
2050	$383,000	$3,080,000	$2,700,000	$735,000	$138,000
2051	$383,000	$3,080,000	$2,700,000	$714,000	$129,000
2052	$383,000	$3,080,000	$2,700,000	$693,000	$120,000
2053	$383,000	$3,080,000	$2,700,000	$673,000	$112,000
2054	$383,000	$3,080,000	$2,700,000	$653,000	$105,000
2055	$383,000	$3,080,000	$2,700,000	$634,000	$98,100
2056	$383,000	$3,080,000	$2,700,000	$616,000	$91,700
2057	$383,000	$3,080,000	$2,700,000	$598,000	$85,700
2058	$383,000	$3,080,000	$2,700,000	$581,000	$80,100
2059	$383,000	$3,080,000	$2,700,000	$564,000	$74,800
2060	$383,000	$3,080,000	$2,700,000	$547,000	$69,900
2061	$383,000	$3,080,000	$2,700,000	$531,000	$65,000
2062	$383,000	$3,080,000	$2,700,000	$516,000	$61,100
2063	$383,000	$3,080,000	$2,700,000	$501,000	$57,100
2064	$383,000	$3,080,000	$2,700,000	$486,000	$53,300
2065	$383,000	$3,080,000	$2,700,000	$472,000	$49,900
2066	$383,000	$3,080,000	$2,700,000	$458,000	$46,600
2067	$0	$3,080,000	$3,080,000	$508,000	$49,700
2068	$0	$3,080,000	$3,080,000	$493,000	$46,500
2069	$0	$3,080,000	$3,080,000	$479,000	$43,400
2070	$0	$3,080,000	$3,080,000	$465,000	$40,600
2071	$0	$3,080,000	$3,080,000	$451,000	$37,900
2072	$0	$3,080,000	$3,080,000	$438,000	$35,500
2073	$0	$3,080,000	$3,080,000	$426,000	$33,100
2074	$0	$3,080,000	$3,080,000	$413,000	$31,000
2075	$0	$3,080,000	$3,080,000	$401,000	$28,900
2076	$0	$3,080,000	$3,080,000	$389,000	$27,100
2077	$0	$3,080,000	$3,080,000	$378,000	$25,300
2078	$0	$3,080,000	$3,080,000	$367,000	$23,600
2079	$0	$3,080,000	$3,080,000	$356,000	$22,100
2080	$0	$3,080,000	$3,080,000	$346,000	$20,600
2081	$0	$3,080,000	$3,080,000	$336,000	$19,300
2082	$0	$3,080,000	$3,080,000	$326,000	$18,000
2083	$0	$3,080,000	$3,080,000	$317,000	$16,800
2084	$0	$3,080,000	$3,080,000	$307,000	$15,700
2085	$0	$3,080,000	$3,080,000	$298,000	$14,700
2086	$0	$3,080,000	$3,080,000	$290,000	$13,800
2087	$0	$3,080,000	$3,080,000	$281,000	$12,900
2088	$0	$3,080,000	$3,080,000	$273,000	$12,000
2089	$0	$3,080,000	$3,080,000	$265,000	$11,200
2090	$0	$3,080,000	$3,080,000	$257,000	$10,500
2091	$0	$3,080,000	$3,080,000	$250,000	$9,800
2092	$0	$3,080,000	$3,080,000	$243,000	$9,160
2093	$0	$3,080,000	$3,080,000	$236,000	$8,560
2094	$0	$3,080,000	$3,080,000	$229,000	$8,000
2095	$0	$3,080,000	$3,080,000	$222,000	$7,480
2096	$0	$3,080,000	$3,080,000	$216,000	$6,990
2097	$0	$3,080,000	$3,080,000	$209,000	$6,530

YEAR	COST OF PRE-COMMERCIAL THINNING	LOST VALUE FROM NOT PRE-COMMERCIAL THINNING	NET IMPACTS OF PRECLUDING PRE-COMMERCIAL THINNING		
			UNDISCOUNTED	PRESENT VALUE 3%	PRESENT VALUE 7%
2098	$0	$3,080,000	$3,080,000	$203,000	$6,110
2099	$0	$3,080,000	$3,080,000	$197,000	$5,710
2100	$0	$3,080,000	$3,080,000	$192,000	$5,330
2101	$0	$3,080,000	$3,080,000	$186,000	$4,980
2102	$0	$3,080,000	$3,080,000	$181,000	$4,660
2103	$0	$3,080,000	$3,080,000	$175,000	$4,350
2104	$0	$3,080,000	$3,080,000	$170,000	$4,070
2105	$0	$3,080,000	$3,080,000	$165,000	$3,800
Total	**$23,400,000**	**$216,000,000**	**$192,000,000**	**$27,100,000**	**$371,000**
Annualized			**$1,920,000**	**$858,000**	**$26,000**

EXHIBIT D-10. SUPERIOR NATIONAL FOREST SUBUNIT: EXAMPLE OF SCENARIO 2 IMPACT CALCULATION (2006- 2025)

YEAR	SCENARIO 1 IMPACTS			PRE-COMMERCIAL THINNING IMPACTS			SCENARIO 2 IMPACTS		
	UNDISCOUNTED	PRESENT VALUE 3%	PRESENT VALUE 7%	UNDISCOUNTED	PRESENT VALUE 3%	PRESENT VALUE 7%	UNDISCOUNTED	PRESENT VALUE 3%	PRESENT VALUE 7%
2006	$175,000	$175,000	$175,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,030,000	$201,000
2007	$175,000	$170,000	$164,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,030,000	$190,000
2008	$175,000	$165,000	$153,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,020,000	$179,000
2009	$175,000	$160,000	$143,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,020,000	$169,000
2010	$175,000	$155,000	$134,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,010,000	$160,000
2011	$175,000	$151,000	$125,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,010,000	$151,000
2012	$175,000	$147,000	$117,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,000,000	$143,000
2013	$175,000	$142,000	$109,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,000,000	$135,000
2014	$175,000	$138,000	$102,000	$1,920,000	$858,000	$26,000	$2,100,000	$996,000	$128,000
2015	$175,000	$134,000	$95,200	$1,920,000	$858,000	$26,000	$2,100,000	$992,000	$121,000
2016	$175,000	$130,000	$89,000	$1,920,000	$858,000	$26,000	$2,100,000	$988,000	$115,000
2017	$175,000	$126,000	$83,100	$1,920,000	$858,000	$26,000	$2,100,000	$984,000	$109,000
2018	$175,000	$123,000	$77,700	$1,920,000	$858,000	$26,000	$2,100,000	$981,000	$104,000
2019	$175,000	$119,000	$72,600	$1,920,000	$858,000	$26,000	$2,100,000	$977,000	$98,600
2020	$175,000	$116,000	$67,900	$1,920,000	$858,000	$26,000	$2,100,000	$974,000	$93,900
2021	$175,000	$112,000	$63,400	$1,920,000	$858,000	$26,000	$2,100,000	$970,000	$89,400
2022	$175,000	$109,000	$59,300	$1,920,000	$858,000	$26,000	$2,100,000	$967,000	$85,300
2023	$175,000	$106,000	$55,400	$1,920,000	$858,000	$26,000	$2,100,000	$964,000	$81,400
2024	$175,000	$103,000	$51,800	$1,920,000	$858,000	$26,000	$2,100,000	$961,000	$77,800
2025	$175,000	$99,800	$48,400	$1,920,000	$858,000	$26,000	$2,100,000	$958,000	$74,400
Total	$3,500,000	$2,680,000	$1,980,000	$38,500,000	$17,200,000	$520,000	$42,000,000	$19,800,000	$2,500,000
Annualized	$175,000	$180,000	$187,000	$1,920,000	$858,000	$26,000	$2,100,000	$1,330,000	$236,000

17. The difference in per acre impacts across the Units results from the underlying assumptions in the Wagner model applied in Maine and the simplified model used to estimate impacts in Minnesota and Montana. The model applied in Minnesota and Montana does not include impacts related to lost cash flows that would result from delaying harvests across ownerships (e.g., allowable cut effects).[12] If owners are no longer able to increase growth through yield enhancing practices such as pre-commercial thinning, they may compensate by adjusting harvest schedules to make standing timber last longer. The analysis in Minnesota and Montana only accounts for a reduction in harvest at the time at which increased yields would have been available on thinned acres.

D.1.3 ADDITIONAL BREAKDOWN OF MINNESOTA IMPACTS

18. Some tax-forfeit lands managed for timber purposes by Minnesota counties are included in the MNDNR and Unknown Landowner subunits.[13] This section details the allocation of these impacts to Minnesota counties.

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19. The MNDNR subunit includes 253,737 acres managed by St. Louis County, 11,970 acres managed by Lake County, and 4,982 acres managed by Koochiching County; the remaining 236,780 acres of this subunit is assumed to be timberlands managed by MNDNR. Based on these acreages, impacts broken down as illustrated in Exhibit D-11.

EXHIBIT D-11. BREAKDOWN OF SCENARIO 2 IMPACTS: UNIT 2 MNDNR LANDS (2006 – 2025)

LANDOWNER	UNDISCOUNTED	PRESENT VALUE AT 3%	PRESENT VALUE AT 7%
MNDNR	$96,300,000	$8,580,000	$186,000
Koochiching County	$2,030,000	$181,000	$3,910
Lake County	$4,870,000	$434,000	$9,380
St. Louis County	$103,000,000	$9,200,000	$199,000
Totals	$206,000,000	$18,400,000	$398,000

Note: Totals may not sum due to rounding. Cook County not included because it has less than five acres in this subunit.

20. The Unknown landowner subunit includes 163,944 acres managed by St. Louis County, 102,521 acres managed by Lake County, and 7,236 acres managed by Koochiching County.[14] For purposes of this analysis, the remaining 615,817 acres are assumed to be private timberlands.

[12] Allowable cut effect is defined as: "the allocation of anticipated future timber yields to the present allowable cut. Note: the allowable cut effect is employed to increase current harvest levels by spreading future growth over all the years in a rotation." (Seven Islands Land Co. website, http://www.sevenislands.com/General_Terms.htm.)

[13] Acreages used to calculate impacts were based on IEc GIS analysis of GIS data provided by St. Louis County and Lake County, and GIS data available from MNDNR.

[14] Based on IEc GIS analysis.

21. Based on these acreages, the breakdown of impacts under Scenario 1 and Scenario 2 are presented in Exhibits D-12 and D-13, respectively.

EXHIBIT D-12. BREAKDOWN OF SCENARIO 1 IMPACTS: UNIT 2 UNKNOWN LANDOWNER (2006 – 2025)

LANDOWNER	UNDISCOUNTED	PRESENT VALUE AT 3%	PRESENT VALUE AT 7%
Private Timber Lands	$3,690,000	$3,410,000	$3,090,000
Koochiching County	$43,300	$40,000	$36,300
Lake County	$614,000	$567,000	$515,000
St. Louis County	$981,000	$907,000	$823,000
Totals	$5,320,000	$4,92,000	$4,460,000
Note: Totals may not sum due to rounding. Cook County not included as it has less than five acres in this subunit.			

EXHIBIT D-13. BREAKDOWN OF SCENARIO 2 IMPACTS: UNIT 2 UNKNOWN LANDOWNER (2006 – 2025)

LANDOWNER	UNDISCOUNTED	PRESENT VALUE AT 3%	PRESENT VALUE AT 7%
Private Timber Lands	$53,800,000	$25,700,000	$3,770,000
Koochiching County	$632,000	$302,000	$44,300
Lake County	$8,950,000	$4,280,000	$627,000
St. Louis County	$14,300,000	$6,850,000	$1,000,000
Totals	$77,700,000	$37,200,000	$5,440,000
Note: Totals may not sum due to rounding. Cook County not included because it has less than 5 acres in this subunit.			

D.2 SENSITIVITY ANALYSIS

22. Because the actual amount of pre-commercial thinning occurring in the study area outside of Maine is not known, the analysis assumes that one percent of timberlands in the study area in Minnesota and Montana would be pre-commercially thinned in the absence of lynx conservation efforts. In Maine, based on available information, approximately 0.27 percent of timberland in the study area was pre-commercial thinned in 2004.[15] To test the sensitivity of our model to this assumption of acreage pre-commercially thinned annually, the model for Minnesota and Montana was run applying the assumption of 0.27 percent in place of one percent. The comparison of results for subunits where pre-commercial thinning acreage is not known is shown below in Exhibit D-14.

[15] Approximately 16,417 acres of pre-commercial thinning were conducted in the northern region of Maine in 2004 (Email communication with Ken Laustsen, Maine Forest Service). This is equivalent to 0.27 percent of the 6.3 million acres of timberland in the study area in Maine.

EXHIBIT D-14. SENSITIVITY ANALYSIS: 1% VERSUS 0.27% ANNUAL PRE-COMMERCIAL THINNING ACREAGE

CRITICAL HABITAT UNIT	SUBUNIT	ASSUMING 1% OF ACREAGE PRE-COMMERCIAL THINNING		ASSUMING 0.27% OF ACREAGE PRE-COMMERCIAL THINNING	
		ANNUAL ACREAGE OF PRE-COMMERCIAL THINNING	TOTAL UNDISCOUNTED IMPACTS (2006 – 2105)	ANNUAL ACREAGE OF PRE-COMMERCIAL THINNING	TOTAL UNDISCOUNTED IMPACTS (2006 – 2105)
Unit 2: Minnesota	Superior National Forest	4,734	$192,000,000	1,278	$52,000,000
	MNDNR	5,075	$206,000,000	1,370	$55,700,000
	Private Timber Lands	121	$4,910,000	33	$1,330,000
	Unknown	8,895	$362,000,000	2,402	$97,600,000
Unit 3: Northern Rockies	Montana University System	217	$30,500,000	58	$8,230,000
	Private Timber Lands	4,282	$603,000,000	1,156	$163,000,000
	Unknown	6,440	$907,000,000	1,739	$245,000,000